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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/808,180	03/24/2004	Joseph Pierre Heremans	65899-0726	4588

10291 7590 02/21/2008
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EXAMINER	
SALZMAN, KOURTNEY R	

ART UNIT	PAPER NUMBER
1795	

MAIL DATE	DELIVERY MODE
02/21/2008	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/808,180	HEREMANS ET AL.	
	Examiner	Art Unit	
	KOURTNEY R. SALZMAN	4128	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE _3_ MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on _27 December 2007_.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) _1-25_ is/are pending in the application.

4a) Of the above claim(s) _8-25_ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) _1-7_ is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _March 24, 2004_.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

5) ☐ Notice of Informal Patent Application

6) ☐ Other: _____.

DETAILED ACTION

Election/Restrictions

1. Applicant's election with traverse of group I, claims 1-7, in the reply filed on December 27, 2007 is acknowledged. The traversal is on the ground(s) that the product and the method of making are not different inventions. This is not found persuasive because even though the product and method of making share characteristics, the limitations are not found to be in the same search or classification.

The requirement is still deemed proper and is therefore made FINAL.

2. Claims 8-25 are withdrawn from further consideration pursuant to 37 CFR 1.142(b), as being drawn to a nonelected method of making a thermoelectric material, there being no allowable generic or linking claim. Applicant timely traversed the restriction (election) requirement in the reply filed on December 27, 2007.

Summary

3. This is the initial Office Action on application number 10/808,180 entitled Thermoelectric Materials With Enhanced Seebeck Coeffiecient, filed March 24, 2004. This application claims priority from provisional application 60/458,129, filed March 27, 2003.

4. Claims 1-7 have been fully considered.

Claim Rejections - 35 USC § 102

5. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

6. Claim 1 is rejected under 35 U.S.C. 102(b) as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over SAKAKIBARA et al (US 6,225,548).

SAKAKIBARA et al teaches a thermoelectric semiconductor compound comprising specific thermoelectric characteristics. In column 2, line 61—column 3, line 5, SAKAKIBARA et al teaches an average diameter of the material to be reference character D. SAKAKIBARA et al then states the compound, "complies with the formula of A<D<B", where A is the mean free path of a carrier in a single crystal and B is the mean free path of a long wave phonon in the single crystal of a semiconductor. This requirement is designated as the second semiconductor material constraint, showing this is before the processing takes place, as shown in figure 2, where mixing is the first step. The phonon-limited mean free path would fall between the values of A and B. The example shown in column 3, lines 23-31, for a molecule with a diameter of 10 μm, a range of mean paths falls between .01 μm and 100 μm, which falls entirely within the range defined by the instant application.

In the alternative, while SAKAKIBARA et al does not inherently teach the range confined by the photon-limited mean free path value, it does show the diameter being within a range of mean free path values of a material. It shows that by optimizing that range, the performance index Z of the semiconductor material dramatically increases making it a better thermoelectric conductor, as is stated in the abstract. As nearly all materials can be manipulated in order to achieve the characteristics desired, optimization is a reasonable ability in order to provide any desired thermoelectric grain size.

Claim Rejections - 35 USC § 103

7. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

8. Claims 2 and 4 are rejected under 35 U.S.C. 103(a) as being unpatentable over SAKAKIBARA et al (US 6,225,548) in view of KUDMAN et al (US 3,737,345)

SAKAKIBARA et al teaches all the limitations of claim 1.

SAKAKIBARA et al fails to teach the use of PbTe or any of the compounds PbSe, PbS, SnTe or SnSe.

Regarding claim 2, in conjunction with the previous rejection of claim 1, KUDMAN et al teaches a thermoelectric element comprising, "a body of PbTe". (column 1, lines 45-47)

Regarding claim 4, in conjunction with the previous rejection of claim 1, KUDMAN et al teaches a thermoelectric element comprising, "a body of PbTe and/or PbSe". (column 1, lines 45-47)

At the time of invention, it would have been obvious to one of ordinary skill in the art to use the PbTe or PbSe materials disclosed in KUDMAN et al to make the thermoelectric material of SAKAKIBARA et al, because KUDMAN et al discloses the benefits of the PbTe and PbSe materials. In column 1, lines 14-19, KUDMAN et al teaches, "Among the most efficient thermoelectric elements for the thermoelectric generation of power at temperatures above 200°C are thermoelectric elements comprising PbTe (lead telluride) and/or PbSe (lead selenide)". The efficiencies of these materials as disclosed in KUDMAN et al make the use of them in the thermoelectric material of SAKAKIBARA et al an obvious choice in the art.

9. Claim 3 is rejected under 35 U.S.C. 103(a) as being unpatentable over SAKAKIBARA et al (US 6,225,548) and KUDMAN et al, as applied to claim 2 above, and further in view of SUZUKI et al (PG PUB US 2002/0026856).

SAKAKIBARA et al teaches all the limitations of claim 1 and the combination of SAKAKIBARA et al and KUDMAN et al teach all the limitations of claim 2.

The combination of SAKAKIBARA et al and KUDMAN et al fail to teach the size of the particles of the thermoelectric material.

Regarding claim 3, in conjunction with the previous rejection of claims 1 and 2, SUZUKI et al teaches a thin film thermoelectric material comprising nanometer-sized particles, “having their diameters distributing within the range of .5 nm through 100 nm", as stated in paragraph 16. SUZUKI et al also acknowledges the commonality of PbTe as an effective thermoelectric material, in paragraph 4.

At the time of the invention, it would be obvious to use the nanometer scale particles disclosed in SUZUKI et al in lieu of the micron scale particles of SAKAKIBARA et al and KUDMAN et al, because the marketplace reflects the trend of making commonly sized micron scale materials nanoscale. As modern thermoelectrics and semiconductors become smaller and more efficient, it would be obvious to make the thermoelectric material disclosed in SAKAKIBARA et al and KUDMAN et al in the size of the SUZUKI et al disclosed material, in order to gain the commonly understood benefits of such adaptation, as still achieve a predictable result. In addition, SAKAKIBARA et al teaches in the examination of variations of performance index Z varies with average particle diameter. The

performance index, which considers the corresponding Seebeck coefficient, electrical and thermal conductivity, improved as the grain size decreased. (column 5, lines 6-16) This would prove to be a predictable result, that when the material of SAKAKIBARA et al and KUDMAN et al is processed to a smaller grain size, the Z index and in turn the Seebeck coefficient improves. Improved Seebeck coefficient allows for the thermoelectric material to be more efficient, consistent goal in the art. Therefore, because through decreasing grain size, thermoelectric materials are able to reach industry ideals for small thermogranular material and reach more optimal performance through enhanced Seebeck effect, it would be obvious to one of ordinary skill in the art to process the thermogranular material as disclosed in SAKAKIBARA et al and KUDMAN et al in the sizing presented in SUZUKI et al.

10. Claims 5 and 7 is rejected under 35 U.S.C. 103(a) as being unpatentable over SAKAKIBARA et al (US 6,225,548), in view of SUZUKI et al (PG PUB US 2002/0026856).

SAKAKIBARA et al teaches all the limitations of claim 1.

SAKAKIBARA et al fails to teach the material to be of either Bi_2Te_3, Bi_2Se_3, Sb_2Te_3 or Sb_2Se_3 or the size of the compound to be nanoscale, but rather microscale.

Regarding claim 5, in conjunction with the previous rejection of claim 1, SUZUKI et al teaches a thin film thermoelectric material possibly comprising thermoelectric materials including Bi_2Te_3, in paragraph 4.

At the time of the invention, it would be obvious to use Bi_2Te_3, as disclosed in SUZUKI et al, as a thermoelectric compound in the material of SAKAKIBARA et al, because Bi_2Te_3 is a commonly accepted material as a thermoelectric, as disclosed in the description of related art section of SUZUKI et al, paragraph 4. SUZUKI et al acknowledges the use of this material as an obvious choice for the construction of a thermoelectric device. Therefore, the addition of the Bi_2Te_3 material of SUZUKI et al in the thermoelectric device disclosed in SAKAKIBARA et al is obvious because it is known in the art that the addition of Bi_2Te_3 would yield a predictably functioning material as a commonly accepted thermoelectric material, for use in the conversion of heat into electricity.

Regarding claim 7, in conjunction with the previous rejection of claim 1, SUZUKI et al teaches a thin film thermoelectric material comprising nanometer-sized particles, “having their diameters distributing within the range of .5 nm through 100 nm", as stated in paragraph 4.

At the time of the invention, it would be obvious to use the nanometer scale particles disclosed in SUZUKI et al in lieu of the micron scale particles of SAKAKIBARA et al, because the marketplace reflects the trend of making commonly sized micron scale materials nanoscale. As modern thermoelectrics and semiconductors become smaller and more efficient, it would be obvious to make the thermoelectric material disclosed in SAKAKIBARA et al in the size of the SUZUKI et al disclosed material, in order to gain the commonly understood benefits of such adaptation, as still achieve a predictable result. In addition, SAKAKIBARA et al teaches in the examination of variations of performance index Z varies with average particle diameter. The performance index, which considers the corresponding Seebeck coefficient, electrical and thermal conductivity, improved as the grain size decreased. (column 5, lines 6-16) This would prove to be a predictable result, that when the material of SAKAKIBARA et al is processed to a smaller grain size, the Z index and in turn the Seebeck coefficient improves. Improved Seebeck coefficient allows for the thermoelectric material to be more efficient, consistent goal in the art. Therefore, because through decreasing grain size, thermoelectric materials are able to reach industry ideals for small thermogranular material and reach more optimal performance through enhanced Seebeck effect, it would be obvious to one of ordinary skill in the art to process the thermogranular material as disclosed in SAKAKIBARA et al in the sizing presented in SUZUKI et al.

11. Claim 6 is rejected under 35 U.S.C. 103(a) as being unpatentable over SAKAKIBARA et al, in view of SHARP (US 6,169,245).

SAKAKIBARA et al teaches all the limitations of claim 1.

SAKAIBARA et al fails to explicitly teach the use of BiSb as a thermoelectric material.

SHARP teaches the use of thermoelectric materials including ternary penta telluride and selenide compounds. SHARP acknowledges, in column 2, lines 33-36, the use of BiSb as a thermoelectric material.

At the time of invention, it would have been obvious to one of ordinary skill in the art to combine the use of a BiSb material, as disclosed in SHARP et al, in the thermoelectric material of SAKAKIBARA et al because SHARP et al discloses the use of BiSb as a thermoelectric material known in the art for “thirty or forty years ago”, in column 2, lines 33-34. The fact that the BiSb material is established and well known in the art for its thermoelectric capabilities, makes the addition of the BiSb material as disclosed in SHARP and obvious choice as a thermoelectric material as in SAKAKIBARA et al, for its commonly known use in the art.

Conclusion

12. Any inquiry concerning this communication or earlier communications from the examiner should be directed to KOURTNEY R. SALZMAN whose telephone number is (571)270-5117. The examiner can normally be reached on Monday to Friday 7AM to 4PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Barbara Gilliam can be reached on (571) 272-1330. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Barbara L. Gilliam/
Supervisory Patent Examiner, Art Unit 4128

krs